

APPLICATION OF LOGISTICS TECHNOLOGIES IN PASSENGER TRANSPORT IN THE CONTEXT OF THE COVID-19 PANDEMIC

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<https://doi.org/10.37904/clc.2022.4566>

Abstract

The relationship between logistics and transport is very close, as transport ensures the physical movement of the product from the place of production to the place of consumption. Transport is a significant factor of time, it is the bearer of the speed and reliability of product relocation, it is one of the most important elements of the logistics system. It forms a very important and irreplaceable place in the logistics chain from the material supplier to the customer. In passenger rail transport, logistics deals mainly with the planning, organization, management and control of all activities between entities entering the transport process, and thus creates the conditions for ensuring safe, reliable, sufficiently fast and convenient passenger transport at optimal prices in cooperation with other modes of transport. The basic strategic goal is to ensure maximum fast, high-quality and convenient transport services in the area with a positive impact on the optimal interconnection of individual regions and their economic development. The ideal solution is to introduce an integrated transport system, in which transport and tariff conditions are unified. The larger the integrated transport system in place, the better for the traveling public, and at the same time the logistics of public passenger transport operate at a higher level. The article focuses on the relationship and functions of city logistics, The main contribution goal is application of some logistics technologies to transport services in passenger transport, as well as the comparison of transport chains in passenger transport.

Keywords: Logistics technologies, covid-19 pandemic, passenger transport, city logistic

1. INTRODUCTION

Rail transport is not nearly a guarantee of such quality accessibility and flexibility as road transport, but its function is very important in logistics. It can provide transport in much larger quantities in the case of freight it also offers the possibility to transport heavy consignments, consignments with specific characteristics, etc. [1]. However, good transport chain management does not mean social engineering or central planning, but is based on market principles of guiding transport demand by offering more reliable, faster, better and, if possible, cheaper systems [2]. Today when a great emphasis is put on the quality and high level of provided services the application of optimisation methods in logistic processes is a necessity. The article addresses the optimisation of transport processes within a logistic chain [3,4]. City logistics is a process of optimizing logistics and transport activities involving private companies with the support of advanced information systems in the city with regard to the transport environment and its impact on congestion, security and energy savings. "One of the tasks of city logistics is to provide comprehensive transport service. There are several reasons why city logistics is paying more and more attention [5]. These include environmental reasons (negative impacts of traffic on their surroundings, such as noise, fumes, land use), traffic reasons and living standards in the city. Improving the traffic situation, mitigating negative impacts on the surroundings or reducing traffic in a selected area or time can significantly help to improve the living standards of the city's inhabitants. The mentioned topic

is currently very important. Therefore, the main purpose of the article deals with the city logistics functions, application of logistics technologies to transport services in passenger transport, including transport chains proposals in passenger transport. [6]

2. CITY LOGISTICS FUNCTIONS

In the classical understanding of logistics, relating only to the area of freight transport, three stakeholders are involved in the solution - the carrier, the municipality and the private sector - the so-called logistics city triangle. If we extend the scope of logistics to the area of passenger transport, we must also increase the number of participants who will be involved in creating solutions. These are mainly passenger transport companies, the police force and, last but not least, citizens [5]. The main tasks of logistics in passenger rail transport are mainly [7]:

- examination of transport flows of passengers in certain time positions on transport routes using various detection - marketing methods,
- optimization and control of these transport flows,
- improving individual factors of the transport process,
- improving the relationship with customers,
- provision of quality services and optimal travel culture - cleanliness and comfort of the means of transport, seating position, technical condition of the vehicle,
- ensure the optimal price and simplicity of customer handling, solve a complex logistics chain - the way from house to house.

The basic concepts of logistics services in the city and territory in the field of freight and passenger transport are basically two logistics technologies - Hub and Spoke and the Gateway concept [8].

The concept of **Hub and Spoke technology** is based on the existence of one logistics center (hub = center, core), from which the service of the area (spoke = beam, peak, partition) is transferred. The logistics center is always asymmetrical with respect to the city center. Technology presupposes the existence of the need to supply the territory (households, small and medium-sized enterprises) with materials and raw materials. At the same time, the dispatch of products, including waste from the sphere of trade and consumption, is also expected. Transport services for large production centers are not expected, as they usually have their own corporate logistics system or outsource their logistics. [9]. In the **Figure 1** is shown principle of Hub and Spoke technology, which is useable in passenger transport.

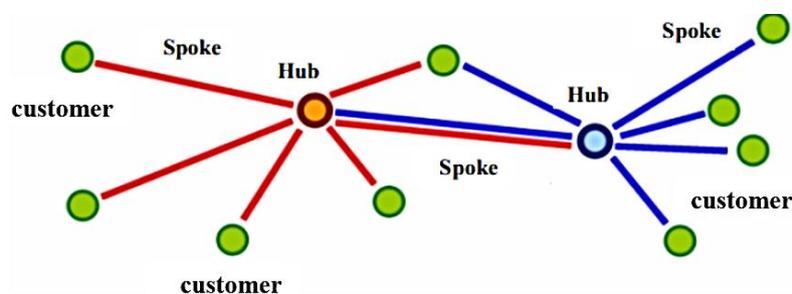


Figure 1 The principle of Hub and Spoke technology [10].

Gateway logistics technology is suitable for logistics transport services of large nuclear cities, ie for the application of "City Logistics". At the entrances to the core city, "Gateways" have been built on major transport routes, which are a functional equivalent of logistics centers in Hub and Spoke technology [10]. The basic principle of Gateway technology is shown in **Figure 2**.

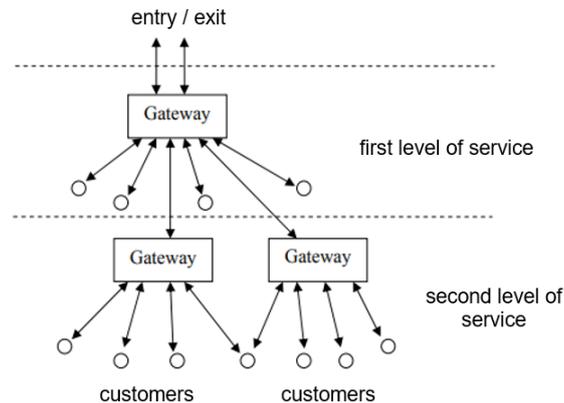


Figure 2 The basic principle of Gateway technology [10].

3. APPLICATION OF LOGISTICS TECHNOLOGIES IN PASSENGER TRANSPORT DURING THE COVID-19 PANDEMIC

In addition to positive effects such as comfort and travel speeds, expanding individual car traffic brings many negative side effects such as overcrowded and often obturated urban agglomerations, a significant increase in exhaust gasses, higher noise, and so on. This problem can only be resolved by functional public passenger transport as a full-fledged alternative to individual transport, which will, as far as possible, be addressed to the widest possible population [11,12]. It is essential to create the conditions for the coordination of individual and public passenger transport, as it currently is in the case of logistics in freight transport. It is necessary to ask whether the general logistic principles used for the space-time transfer of some objects can be used in passenger transport [13]. The division of relocation needs is shown in **Figure 3**.

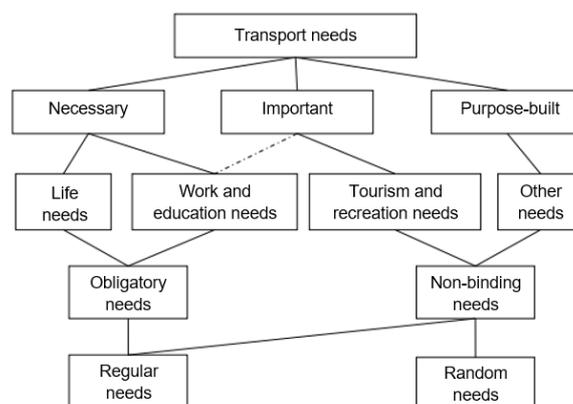


Figure 3 Division of relocation needs [authors]

The possibilities of the application are influenced by the category of the served area, ie its size and number of inhabitants. This then results in the number of operating modes and transport systems. The choice of a suitable transport system depends on the size of the core city and the whole agglomeration. The actual implementation of comprehensive logistics services of agglomerations is supported by other transport systems that are technically, transportably or transportably connected to the supporting integrated transport [14,15]. These systems should also be used during a COVID-19 pandemic, as they limit direct encounters with people and minimize the spread of COVID-19. They are mainly [16].

- transport system Park & Ride (P+R),
- transport system Bike&Ride (B+R),

- transport system Kiss & Ride (K+R),
- shared transport system.

Transport chains in passenger transport

If we do not take into account the transport that is provided on the entire route by individual transport, we can generally create a transport system for transporting people consisting of three main elements (subsystems) between the start and the end of the transport [17]:

- Subsystem I links the start of the journey with the access point to some public transport means,
- Subsystem II provides transportation between the two access points. According to the transport variant, the individual subsystems come from a variety of different elements and from different types of elements.
- Subsystem III links the public transport access point with the point at the end of the journey.

Main elements of transport system in passenger transport are shown in the figure 4.

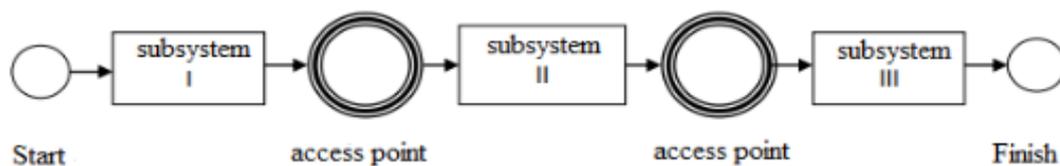


Figure 4 Main elements of transport system in passenger transport [17].

Subsystems I and III are evaluated analogically. These come in four proposals [17].

- The access point is accessible from the beginning of the journey on foot. This requires only a passive connecting element between the two sites (footpaths).
- The access point can only be reached by a means of transport from the beginning of the journey. In addition to the passive (road) and active (vehicle) linking element, accumulating elements (car parks) on the access points as well as linking elements (walkways, lifts, escalators, etc.) between the car park and the public transport platforms are also recommended.
- The access point is available by taxi. This requires a passive link (road) and an active linking element (taxi).
- The access point is accessible by means of individual transport, which is further transported by a public means of transport. In this case, no storage or accumulating element is required at the access point. In order to load the road vehicle on public transport, the linking element (ramp) is necessary at least when dealing with passenger cars.

Subsystem II, which connects the access points, may consist of the following elements [17]:

- Passive (road) and active (vehicle, public means of transport) connecting elements which ensure relocation,
- Transit nodes enabling passengers to travel among different transport modes or various connections of the same transport mode,
- Accumulating places allowing short-term (waiting rooms) or long-term (dormitories) stay during transportation.

During the COVID-19 pandemic, public passenger transport performance fell sharply. The reason was the introduction of measures against the spread of the COVID-19 pandemic in public passenger transport and with them a restriction of the free movement of the population or a curfew. Therefore, it is important to design a concept within the logistics chain in passenger transport, which will lead to greater use of public passenger

transport in the time of the COVID-19 pandemic or another pandemic (observing the established pandemic measures).

Concept of logistics chain in passenger transport (from individual motorism towards public passenger transport) is shown in **Figure 5**.

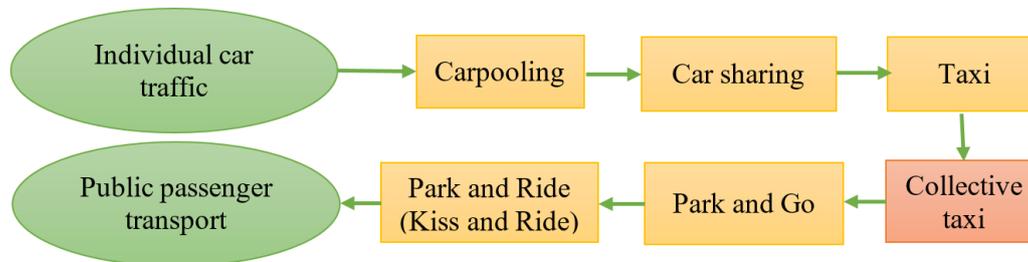


Figure 5 Concept of logistics chain in passenger transport [authors].

In figure 6 we can see concept of logistics chain in passenger transport (from individual motorism towards public passenger transport) in the context of COVID-19 measures.

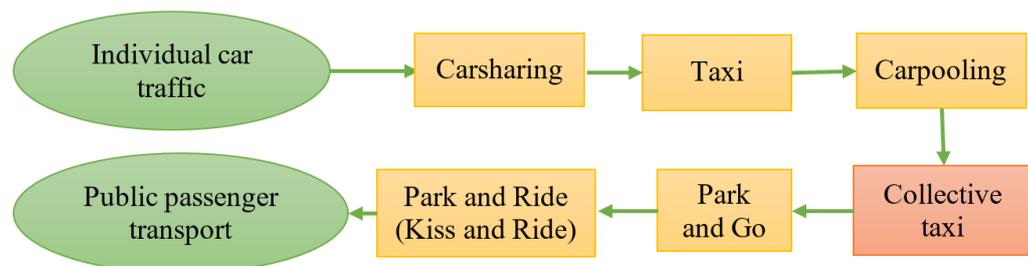


Figure 6 Concept of logistics chain in passenger transport in the context of COVID-19 measures [authors].

The collective taxi can only be used within the established COVID measures. For example, if members of the same household or family members use this method. Also in the case of vaccinated or overcoming persons (OTP mode).

4. CONCLUSION

The mere introduction of the mentioned concepts of transport services of a city or agglomeration in passenger transport (integrated transport system) is not the final solution of a complex logistics service. The development and current state of the integrated transport system in Slovakia can serve as an example. In order to maintain a truly comprehensive and high-quality service to the city or region, a constant systematic analysis of the transport, technological and socio-economic processes that take place in a given place is necessary. At the same time, it is obvious that the fulfillment of quality criteria must be monitored in connection with the optimization of transport costs and prices. From the description of the elements and subsystems of the passenger transport system, it is clear that it creates important cutting points where it is necessary to ensure coordination between individual carriers and different modes of transport, which creates great logistical potential for transport business to meet passenger needs. For the creation of transport models and design of the logistics chain concept in passenger transport leading from individual car transport to public passenger transport and in the context of the COVID-19 pandemic, it is necessary to know in detail not only the current situation in passenger transport logistics, as well as the nature and basic principles of logistics. logistics technologies and logistics, the structure of the transport chain in passenger transport, as well as the current pandemic situation of the city, region or state.

ACKNOWLEDGEMENT

This publication was created thanks to support under the Operational Program Integrated Infrastructure for the project: Identification and possibilities of implementation of new technological measures in transport to achieve safe mobility during a pandemic caused by COVID-19 (ITMS code: 313011AUX5), co-financed by the European Regional Development Fund.

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